

United States Department of Agriculture,

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

GRASS AND FORAGE PLANT INVESTIGATIONS ON THE PACIFIC COAST.*

INTRODUCTION.

The Department of Agriculture has from time to time carried on investigations of the grasses on the Pacific coast, but the first really systematic work of this kind dates from a personal visit made to that section during the season of 1898. On this trip a number of the more important localities were visited, especial attention being devoted to the investigation of the present conditions and needs of the range region of central and eastern Washington and Oregon and the areas subjected to the shifting sands along the coast region and at various points along the Columbia River.

Throughout the drier sections east of the Cascades, the carrying capacity of the ranges has been very much reduced through drought and overstocking, and one of the questions of greatest importance in this region has to do with the improvement of the range and bringing it back, if possible, to its original productiveness. The present worn-out condition has undoubtedly resulted from a combination of circumstances. During the years when the ranges were at their period of greatest productiveness, they were grazed to their utmost capacity, and upon the advent of the series of dry seasons, which naturally resulted in light yields of forage, it was necessary to overgraze in order to keep the stock alive. Then, again, the open winters made it possible to keep the stock on the range a much greater portion of the year than previously, and close grazing followed at a season when the grasses could least endure it—namely, in early spring. The grass was given no opportunity to recuperate, and the present worn-out condition of the ranges resulted.

The large number of horses which have ranged over some sections of the country have had much to do with the present depleted condition, while in other sections much injury has been caused by sheep. To any one visiting these grazing regions it is at once apparent that

*This report is based upon personal observations and upon communications received from time to time from Mr. A. B. Leckenby, a special agent of this Division in charge of investigations on the Pacific coast. A report in detail upon the varieties grown by Mr. Leckenby is in preparation.—F. L. S.

drought-resisting grass and forage crops were of the utmost importance as well as improved methods of range management. In many sections the native grasses have been driven out and their places taken by weeds to such an extent that reseeding is about the only way that the lands can be restored to anything like their original productiveness. To do this, grasses and forage crops capable of enduring severe drought and other hardships are necessary. It seemed desirable to select some point or points where experiments could be conducted, having for their object the testing of drought-resisting grass and forage crops and of the range conditions. With this end in view, a number of localities were visited. At Yakima and Walla Walla, both in the State of Washington, it was found that some work had already been undertaken; that at the former place under the auspices of the Northern Pacific Railway Company, and that at Walla Walla by the Oregon Railroad and Navigation Company. The officials of each of these companies expressed a readiness to cooperate with the Department in continuing in this work of testing grasses and forage crops and range improvements, and went so far as to offer to turn over for the use of the Department the lands occupied by their respective experiment stations and any others that might be deemed suitable or necessary for making such tests. For the station at North Yakima this offer included tools, team, and other appliances used at the station. These offers seeming to afford a desirable opportunity to carry on these much needed investigations, their acceptance was recommended. This recommendation meeting with the approval of the Secretary, the Division took charge of the experimental work at these places, and special efforts were made to collect in quantity the seed of native grasses and forage crops that seemed so desirable to be tested in connection with the work of range improvement.

The investigations on the Pacific slope were continued during the season of 1899, both in the field and at North Yakima, Walla Walla, Rowena, and other points. The Agrostologist and two other members of the office force of the Division staff spent a considerable portion of the summer in the field studying the native grasses of the region and other questions connected with the forage problem.

At various points along the immediate coast and on the Columbia River, the question of fixing the drifting sands is an important one, and much time has been spent in studying the conditions which exist there and in endeavoring to secure practical means of holding the shifting sands in place. At some points along the river the sand occurs in such abundance and drifts so badly that it is a decided menace to orchards and farm crops in the immediate vicinity, and seriously impedes traffic by forming drifts over railroads and other avenues of commerce. In the course of our investigations a number

of native plants have been discovered which promise to be of great value as sand-binders, and some of them also as sources of forage.

Among the more important of these native sand-binders are sea-side, or Astoria, blue grass (*Poa macrantha*); sand blue grass (*Poa leckenbyi*); sea lyme grass (*Elymus arenarius*); yellow lyme grass (*Elymus flavescens*); small sand lyme (*Elymus arenicolus*), similar to the preceding; and a sand-binding sedge (*Carex macrocephala*). Other grasses that are being tested as to their value as sand-binders in this region are big sand grass (*Calamovilfa longifolia*), Marram grass (*Ammophila arenaria*), Bermuda grass (*Cynodon dactylon*), and Johnson grass (*Sorghum halapense*).

EXPERIMENTS AT NORTH YAKIMA AND WALLA WALLA.

In the experiments undertaken at North Yakima and at Walla Walla, a large number of grasses and forage plants have been tested as to their ability to withstand drought, and, in many cases, also have been grown under irrigation. As far as possible these stations have been used in the production of seed to be distributed to the different points in the region where their value under existing conditions can be tested. At North Yakima the land used in these experiments, although rich, is quite rocky, and hence difficult to cultivate, and the general conditions are much less favorable than those which prevail at Walla Walla. At the latter place, the soil is a rich, volcanic ash, and in fine condition for the various operations connected with cultivation, and is so graded that irrigation may be resorted to when necessary. During the present year a considerable amount of seed has been produced, particularly at the Walla Walla station, and this will be used in our investigations for the coming year.

VARIETIES.

In the experiments made at Walla Walla during the past year about 150 varieties of grasses and forage crops have been tested. These include most of the commonly cultivated sorts, varieties recently introduced by the Department of Agriculture through its special agents in foreign countries, and many native species, particularly those of the Rocky Mountains and the region east of the Cascades. Most of the seeding was done during the first half of April.

Of the varieties tested some 25 or more have shown themselves to be adapted to the conditions which prevail in the Northwest and have in most cases given excellent results without artificial watering of any sort. These include varieties adapted to all the various uses in feeding stock; varieties suitable for the ordinary meadows and pastures and also those adapted for use on the drier uplands. They also include annual varieties suitable for use in short rotations and varieties adapted to soils strongly impregnated with alkali. The common

clovers, particularly alsike and mammoth red clover, have given very satisfactory results and the same may be said regarding timothy, meadow fescue, and tall meadow oat-grass. Smooth brome grass has produced the same excellent results here that it has given elsewhere in the Northwest and gives promise of being to the drier sections of this region what the blue grass is to Kentucky and timothy is to the northern States. Of the more recent introductions the Japanese wheat grass promises to be of great value, particularly for winter pasturage, while the varieties of alfalfa from Turkestan and northern Africa seem to possess great powers of adaptability to the conditions which prevail in the semiarid regions.

Some of the best results have been secured from our native grasses. A species of brome, closely related to the rescue grass, has given good yields of seed and forage and seems likely to prove as valuable for the Pacific coast as rescue grass is for the South. Several of the native wheat grasses show wonderful adaptability to cultivation and are destined to assume an important place on our list of forage-producing plants. Four of these deserve especial mention, namely, western wheat grass (*Agropyron spicatum*), meadow wheat grass (*A. pseudorepens*), slender wheat grass (*A. tenerum*), and bunch wheat grass (*A. divergens*). The first three species are suitable for meadows and may be grown either with or without irrigation. The bunch wheat grass is a native of the dry uplands and is likely to prove one of the best grasses for reclaiming the worn-out ranges. The plants thrive under conditions of extreme drought and afford excellent pasturage for all kinds of stock. This is *the* bunch grass of the great grazing regions west of the Rocky Mountains, and formerly occupied extensive areas affording much pasturage. Another native grass which does well under cultivation and which will undoubtedly prove valuable in reseeding the ranges is blue grama, known in Montana as buffalo grass. It is perfectly hardy, responds quickly to cultivation, resists trampling of stock, and affords first-class grazing. Under favorable conditions of soil and moisture it may also be cut for hay. This grass, however, has one drawback in that the seeds are difficult to handle in the various harvesting and seeding operations.

Of the annual grasses Japanese barnyard millet and black Russian broom-corn millet are most deserving of special mention. Both of these made excellent yields of forage and seed and are of undoubted value to this section.

In addition to the above-mentioned grasses and forage plants which may be regarded as of undoubted value to the Pacific coast region, about twenty sorts were successfully grown at Walla Walla the present season, but further experimentation is necessary to decide as to their real value. Most of these, while they made a good growth

of foliage, either failed to produce seeds or showed other characters which may possibly exclude them from the list of varieties of practical utility for general cultivation. Johnson grass made a good yield of forage, but is objectionable to some because of its habit of growth, which, in the South, renders it at times a serious pest in cultivated fields. Both big blue-stem and bushy blue-stem thrive under cultivation, but it is quite difficult to secure seeds that will germinate. The Metcalfe bean made an excellent growth, covering the ground thickly with its leaves and stems, and produced flowers, but did not mature seed. It showed great sensitiveness to frost and stock did not seem to relish the forage obtained from it. Gram, or chick pea, and lentil produced good crops of seed and may prove valuable for use in connection with grain and other feed stuffs in fattening stock.

Quite a number of other grasses, some twenty in all, gave results of sufficient promise to deserve further study and experimentation. These include a number of the indigenous species of *Poa*, *Elymus*, *Paspalum*, and *Muhlenbergia*, which in their native condition are valuable for hay and pasturage. The more important of these are mutton grass (*Poa fendleriana*), smooth bunch grass (*Poa laevigata*), Wyoming blue grass (*Poa wheeleri*), Canadian lyme grass (*Elymus canadensis*), smooth paspalum (*Paspalum laeve*), and wild timothy (*Muhlenbergia racemosa*).

Of the sand-binding grasses which were tested during the season, Marram grass has made a fine growth and will, no doubt, prove as valuable here as it is on the Atlantic coast. Bitter panic grass (*Panicum amarum*) made a good growth, but failed to mature seed, and for this reason may prove to be of less value here than it is along the coast of the Southern States. Reed canary grass (*Phalaris arundinacea*) has made an excellent showing, particularly in situations that are liable to be submerged for some time; for example, along the Columbia River. Even where submerged six weeks during the summer, excellent growth was made early in the spring and late in fall, affording a large amount of forage. In addition to serving as a sand and soil binder, this grass has also made a good showing on the drier land of the experimental plots at Walla Walla, and also at Pullman on the grounds of the State Experiment Station. Small sand lyme grass (*Elymus areniculus*) has made an excellent growth at Walla Walla from roots transplanted from Grants, Oregon, indicating that it will grow on ordinary soil as well as dry, sandy ground, where it occurs naturally. It will undoubtedly be of great value as a sand-binder. Big sand grass (*Calamovilfa longifolia*) has not given very good results and may prove unsuitable to the conditions which prevail on the Pacific coast. Seaside blue grass (*Poa macrantha*) has given excellent results wherever tried and,

especially at the Walla Walla station, seemed to endure the hot, dry weather perfectly. In addition to being one of the best native sand-binders of the coast region, this grass gives promise of being of great value for forage. Seed sown on the sand dunes of the Great Lake region the past season made a good showing, indicating the possibility of introducing this grass into the sandy regions of the interior. Indian millet (*Eriocoma cuspidata*), although not coming very well from the seed, shows indications of being valuable as a sand-binder, especially on relatively high and dry situations. Although the forage is rather harsh, it is often eaten by stock which are especially fond of the rather abundantly produced seeds.

Mr. A. B. Leckenby writes to the Agrostologist, under date of December 11, 1899:

I am delighted to tell you that the *Elymus arenarius* is a grand success, where the water does not remain on it too long, as is also *Elymus arenicolus* and *Elymus flavescens*. You would be delighted to see the grasses growing through seven feet of drifting sand. The *Elymus arenarius* is particularly pleasing because of its luxuriant growth. I planted about one acre with *Elymus flavescens*, Thursday and Friday, with roots procured from the Dalles. I am sending you by same mail some roots of this same grass.

Of the various saltbushes tested, Australian saltbush (*Atriplex semibaccata*) has given the best results of any of the introduced sorts, and white or sweet sage (*Eurotia lanata*) is most promising of the native series. The latter grows naturally on the dry, sterile soils of the ranges and adapts itself readily to cultivated conditions producing an abundance of seed. It will undoubtedly prove of great value for use in reclaiming the worn-out ranges.

In November some very interesting observations were made at the Walla Walla station regarding the behavior of different grasses and forage crops toward the early frosts. A variety of brome grass secured at Portland, Oregon, was not at all injured by the early frosts and remained fresh and green, while nearly related varieties from the Rocky Mountains suffered quite severely. Seaside blue grass and other of the *Poas*, or blue grasses, showed little, if any, effects of the frosts, while the grama grasses and the blue-stems early became dry and brown. Bearded wheat grass (*Agropyron caninum*) remained fresher and greener than either slender wheat grass or western wheat grass. Giant rye-grass (*Elymus condensatus*) was injured while other rye-grasses, such as Canadian rye-grass and Terrell grass, were very slightly affected. Turkestan alfalfa was not injured at all, while Oasis alfalfa from Africa suffered considerably and the commonly-grown variety of alfalfa was slightly injured. Such annuals as bur clover, lentil, and gram were not injured, indicating their possible value for fall and early winter grazing. Smooth brome and Oregon brome were not at all injured and were growing finely.

GRASS AND CLOVERS AVAILABLE FOR USE IN THE UPPER
PACIFIC COAST REGION.

Judging from the results of the experiments conducted at North Yakima and Walla Walla and the information acquired through personal observation of our own field agents and correspondents who are cooperating with the Division, the following grasses may be suggested as available for use in the upper Pacific coast region:

Grasses and clovers for permanent meadows and pastures where the average conditions of soil and climate prevail.—Alsike, mammoth clover, meadow fescue (*Festuca pratensis*), red fescue (*Festuca rubra*), reed fescue (*Festuca arundinacea*), tall meadow oat-grass (*Arrhenatherum elatius*), western wheat grass (*Agropyron spicatum*), meadow wheat grass (*Agropyron pseudorepens*), slender wheat grass (*Agropyron tenerum*), smooth brome (*Bromus inermis*), Kentucky blue grass (*Poa pratensis*), perennial rye-grass (*Lolium perenne*), Turkestan alfalfa (*Medicago sativa* var. *turkestanica*).

As deserving of trial: Wild timothy (*Muhlenbergia racemosa*), bearded wheat grass (*Agropyron caninum*), smooth bunch grass (*Poa laevigata*), mutton grass (*Poa fendleriana*), Terrell grass (*Elymus virginicus*), Wyoming blue grass (*Poa wheeleri*), pale bunch grass (*Poa lucida*), and Oasis alfalfa.

Hardy annuals.—Rescue grass (*Bromus unioloides*), Japanese barnyard millet (*Panicum crusgalli*), Japanese wheat grass (*Brachypodium japonicum*), black Russian broom-corn millet (*Panicum miliaceum*), bur clover (*Medicago denticulata*), spring vetch (*Vicia sativa*), hairy vetch (*Vicia villosa*).

The following are suggested for further trial:

Crowfoot or goose grass (*Eleusine indica*), African millet (*Eleusine coracana*), gram (*Cicer arietinum*), lentil (*Ervum lens*).

Grasses for the dry uplands.—Blue grama (*Bouteloua oligostachya*), side oats grama (*Bouteloua curtipendula*), bunch wheat grass (*Agropyron divergens*), Nevada blue grass (*Poa nevadensis*), sheep fescue (*Festuca ovina*), King's fescue (*Festuca kingii*), white or sweet sage (*Eurotia lanata*), sainfoin (*Onobrychis sativa*), smooth brome.

Sand Binders.—Sea lyme grass (*Elymus arenarius*), slender sand lyme grass (*Elymus arenicolus*), yellow lyme grass (*Elymus flavescens*), Astoria blue grass (*Poa macrantha*), Leckenby's blue grass (*Poa leckenbyi*).

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Approved:

JAMES' WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., December 22, 1899.